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NASA-15205 (June 2004)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA

Superseding NASA-15205 (December 2003)

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DIVISION 15 - MECHANICAL

SECTION 15205

CLEANING PROCEDURES FOR PROCESS PIPING SYSTEMS

06/04

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SECTION 15205

CLEANING PROCEDURES FOR PROCESS PIPING SYSTEMS

06/04

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NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This broadscope section specifies four classes of cleanliness for process piping systems, components and tanks.

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.

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The publications listed below form a part of this section to the extent referenced:

ASTM INTERNATIONAL (ASTM)

ASTM B 479	(2000) Standard Specification for Annealed Aluminum and Aluminum-Alloy Foil for Flexible Barrier Applications, Food Contact and Other Applications
ASTM D 3399	(1981; R 1995) General-Purpose Synthetic Detergent Liquid
ASTM D 4635	(2001) Low-Density Polyethylene Films for General Use and Packaging Applications
ASTM D 538	(1985; R 1997) Trisodium Phosphate
ASTM D 6368	(2002) Standard Specification for Vapor-Degreasing Grade normal - Propyl Bromide
ASTM E 1146	(1997; R 2002) Muriatic Acid (Technical

Grade Hydrochloric Acid)

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-10.1 (1997) Commodity Specification for Nitrogen

SEMICONDUCTOR EQUIPMENT AND MATERIALS INTERNATIONAL (SEMI)

SEMI C28-0301 (1999) Hydrofluoric Acid

SEMI C35-0301 (1999) Nitric Acid

1.2 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01330 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.
****

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Demineralized Water
Drying or Preservation Gas
Filter Discs
Trisodium Phosphate
Nitric Acid
Citric Acid
Muriatic Acid
Hydrofluoric Acid
Detergents
Normal - Propyl Bromide
Tape
Polyethylene Film
Low Water-Vapor Transmission Film
Aluminum Foil

SD-04 Samples

Contractor shall submit the following samples:

Polyethylene Film
Certification Tags
Low Water-Vapor Transmission Film

SD-06 Test Reports

Test reports for quality assurance tests shall be in accordance with tests described in the paragraph entitled, "Quality Assurance," of this section.

Inspection Records of examinations and tests shall be kept current and available to the Contracting Officer.

SD-07 Certificates

Quality assurance plan shall be submitted for the following in accordance with paragraph entitled, "Quality Assurance," of this section.

Inspection Facilities and Services
Contractor's Procedures

1.3 DEFINITIONS

1.3.1 Cleanliness Level Terms

"Particle" includes all foreign matter except fibers, whether metallic or non-metallic.

"Particle size" is the largest particle dimension, in micrometer.

"Fiber" includes all foreign matter having a length greater than 100 micrometer and a length to diameter ratio of at least 10 to 1.

"Significant surfaces" are component surfaces that may come in contact with the service medium.

1.3.2 Cleanliness Level Classifications

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NOTE: Edit the following paragraphs, deleting Classifications not required for the project.
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1.3.2.1 Class I - Oxidizers and Oxidizer Pressurants

Significant surfaces of [Liquid and Gaseous Oxygen] [Nitrogen] [Helium] [Chlorine Trifluoride (CTF)] [_____] Systems shall be subject to Class I cleanliness requirements.

1.3.2.2 Class II - Fuels, Fuel Pressurants and Hydraulics

Significant surfaces of [Liquid and Gaseous Hydrogen] [Hydraulic] [High Purity Air] [_____] Systems shall be subject to Class II cleanliness requirements.

1.3.2.3 Class III - Air, Control and Instrument Pneumatics

Significant surfaces of [Air-pneumatic Control and Instrument Systems, Downstream of Regulatory Panels to the Control Units] [_____] shall be subject to Class III cleanliness requirements.

1.3.2.4 Class IV - Standard Industrial Cleaning

Significant surfaces of [Potable Water] [Industrial Water] [Vacuum] [_____]

shall be subject to Class IV cleanliness requirements.

1.4 QUALITY ASSURANCE

Inspection Facilities and Services used by the Contractor for the performance of specified inspection requirements shall be approved by the Contracting Officer. Inspection records of examinations and tests shall be kept current and available to the Contracting Officer.

[Six] [_____] copies of the Contractor's Procedures describing precleaning, cleaning, handling, preservation, and quality assurance processes shall be submitted for approval prior to usage.

1.4.1 Process Approval

Contractor's Procedures shall include:

Trade names and manufacturer's names, specifications, chemical and physical properties.

Estimated amounts of waste to be generated as a result of the cleaning process for each processing material used.

Processing equipment, including manufacturer, type or model, and size.

In-process control procedures to prevent contamination or latent corrosion, and installation procedures for cleaned components in cleaned systems.

Methods and materials to be used for preservation of cleaned components prior to installation, and of cleaned systems after acceptance.

1.4.2 Cleaning Certification Tags

Tags, as specified, shall be applied to all cleaned systems, assemblies and components, to certify the cleanliness level of the tagged item.

PART 2 PRODUCTS

2.1 DEMINERALIZED WATER

Demineralized water used for rinsing or operations shall have a pH of 6.0 to 8.0, and a specific resistance greater than 50 ohms per cubic millimeter. Water shall be filtered to remove all particles larger than 175 micrometer in any dimension, and there shall be not more than 5 particles between 100-175 micrometer per 500 millimeter sampling.

2.2 DRYING OR PRESERVATION GAS

Air, and nitrogen gas conforming to CGA G-10.1, Grade E, shall be filtered to a 100 micrometer level (absolute). Oil content shall be no greater than 3 parts per million (ppm) by weight and moisture content shall be not greater than 24 ppm by volume.

2.3 FILTER DISCS

Filter discs shall be polytetrafluoroethylene (PTFE) fiber, 5 micrometer size.

2.4   TRISODIUM PHOSPHATE

Trisodium phosphate shall conform to ASTM D 538.

2.5   NITRIC ACID

Nitric acid shall be technical grade, conforming to SEMI C35-0301.

2.6   CITRIC ACID

Citric acid shall be industrial grade.

2.7   MURIATIC ACID (HYDROCHLORIC)

Muriatic acid shall conform to ASTM E 1146.

2.8   HYDROFLUORIC ACID

Hydrofluoric acid shall conform to SEMI C28-0301.

2.9   DETERGENTS, GENERAL PURPOSE

Detergent agents shall conform to ASTM D 3399.

2.10   NORMAL - PROPYL BROMIDE

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NOTE: Normal - Propyl Bromide shall not be used for vessel cleaning where tank entry is required.

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Solvent used for testing or for immersion cleaning shall conform to ASTM D 6368, except that there shall be no particle over 175 micrometer in any dimension and no more than 5 particles from 100 to 175 micrometer in size.

Solvent used for vapor degreasing cleaning processes of stainless steel components shall conform to ASTM D 6368.

2.11   TAPE

Tape shall be waterproof, pressure-sensitive, with plastic film backing material, suitable for temperature range of minus 65 to plus 160 degrees F minus 54 to 71 degrees C.

2.12   POLYETHYLENE FILM

Polyethylene film shall conform to ASTM D 4635, Type [1] [_____].

2.13   LOW WATER-VAPOR TRANSMISSION FILM

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NOTE: This material should meet the requirements of MIL B-22191C, Type 1. ACLAR 33C, as manufactured by Allied Chemical Corp. satisfies this requirement.

****

Film shall be a transparent, flexible, thermoplastic material, made from fluorinated-chlorinated resins, and having high resistance to chemicals and liquid oxygen. Water vapor transmission rate shall be not greater than

0.03 grams per 100 square inches 0.03 grams per 64516 square millimeter per 24 hours.

2.14 ALUMINUM FOIL

Aluminum foil shall conform to ASTM B 479.

2.15 CERTIFICATION TAGS

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NOTE: Coordinate with schedule for tags at the end of this Section.
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Certification tags shall be made of 100 percent bleached chemical wood pulp, coated, with reinforced hole, and 12-inch 300 millimeter long tying [wire] [twine]. Color shall be [white] [_____] [as specified].

PART 3 EXECUTION

3.1 TEST PROCEDURES

3.1.1 Particle Size Determination

The size distribution and quantity of solid particles retained on significant surfaces shall be determined by removing and measuring particles on a minimum 5 percent representative sample of the total surface.

Solid particle contamination per square foot 92903 square millimeter of significant surface, when determined by the following procedure, shall not exceed the specified amount.

Flush the selected sample surface of measured or estimated area with approximately 500 milliliter of demineralized water per square foot 92903 square millimeter. For individual small components having less than one square foot 92903 square millimeter of surface, a minimum of 500 milliliter of flushing fluid shall be used. For piping and large components having greater than three square feet 836127 square millimeter of surface area, three separate samples shall be collected and analyzed. Piping and piping systems shall be sampled at three separate locations as directed by the Contracting Officer. During sampling, the flow velocity through the pipe shall exceed 8 feet 2.44 meter per second, or as approved by the Contracting Officer.

Catch the entire quantity of flushing fluid in precleaned container.

Transfer an equal quantity of unused flushing fluid into a second precleaned container.

Filter both samples of flushing fluid through filter disc, and examine the residue under a 10 to 45 power stereomicroscope. The difference in particle count in each size range shall constitute the solid particle contamination of the entire surface represented. If the allowable limit is exceeded in any range, the entire surface shall be recleaned and the test repeated.

After satisfactory completion of the particle size determination, all surfaces shall be dried and protected against corrosion or recontamination in accordance with accepted procedures, and marked as specified in the

appropriate section.

3.1.2 Moisture Determination

Small components and assemblies with all significant surfaces exposed shall be examined visually for the presence of surface moisture. Moisture content of surfaces in tanks, piping sections and systems shall be determined as follows:

Set up a flow of purge gas through the tank or system such that the flow of purge gas shall contact all significant surfaces. If necessary, several checks may be run covering different portions of the system in order to assure the flow of purge gas over all significant surfaces. Purge gas shall be dry, oil-free Nitrogen. While flowing, velocity of purge gas at any point in the system being checked shall not exceed 60 feet 0.30 meter per minute. System shall be under a static lockup for at least 8 hours prior to sampling.

Measure the moisture content of the effluent gas using a dew point meter. Moisture vapor level above the specification in any tank, system, or sub-system shall be cause for rejection and correction. Correction may be achieved by continuing the flow of purge gas, heating the gas and system if preferred, until a satisfactory moisture vapor level is measured.

3.1.3 Acidity or Alkalinity

External and internal surfaces of cleaned and rinsed components shall be tested with pH-indicating paper while the component is still wet from the last rinse or after wetting the test surface with a few drops of distilled water. Surface acidity or alkalinity shall register a pH between 6.0 and 8.0.

3.2 QUALITY ASSURANCE TESTS

3.2.1 Tests for Class I Cleanliness Requirements

Solid Particle Contamination: There shall be no particles greater than 500 micrometer in any dimension, not more than five particles between 150 and 500 micrometer, not more than one-hundred particles between 5 and 150 microns, and fewer than ten fibers per square foot 92903 square millimeter of significant surface. Maximum fiber length shall not exceed [500] [_____] micrometer.

Moisture Content: If the influent air at the point of delivery has a dew point of minus 80 degrees F 62 degrees C or colder, the effluent dew point shall be minus 60 degrees F 51 degrees C or colder, as measured in effluent purge gas. If the dew point of the furnished gas is warmer than minus 80 degrees F 62 degrees C, the dew point of the effluent must be within 20 degrees F minus 7 degrees C of the influent.

Acidity or Alkalinity: As specified.

Non-Volatile Residue Contamination shall not be greater than 0.001 grams per square foot 0.001 grams per 92903 square millimeter of surface area.

3.2.2 Tests for Class II Cleanliness Requirements

Solid Particle Contamination: There shall be no particles greater than 500

micrometer in any dimension, not more than five particles between 150 and 500 micrometer, not more than one-hundred particles between 5 and 150 microns, and fewer than ten fibers per square foot 92903 square millimeter of significant surface. Maximum fiber length shall not exceed [500] [_____] micrometer.

Moisture Content: If the influent air at the point of delivery has a dew point of minus 65 degrees F 54 degrees C or colder, the effluent dew point shall be minus 45 degrees F 43 degrees Cor colder, as measured in effluent purge gas. If the dew point of the furnished gas is warmer than minus 65 degrees F 54 degrees C, the dew point of the effluent gas shall be within 20 degrees F minus 7 degrees C of the influent.

Acidity or Alkalinity: As specified.

3.2.3 Tests for Class III Cleanliness Requirements

Solid Particle Contamination: There shall be no particles greater than 1500 micrometer in any dimension, not more than fifty particles between 150 and 1500 micrometer, not more than five-hundred particles between 5 and 150 micrometer, and fewer than fifty fibers per square foot 92903 square millimeter of significant surface. Maximum fiber length shall not exceed [_____] micrometer.

Moisture Determination: Total quantity of moisture solvents, and products, including both absorbed surface film and vapor present in the entire system subject to Class III cleanliness requirements, shall not exceed 150 ppm by volume as measured in effluent purge gas.

3.3 INSPECTION PROCEDURES

The Government reserves the right to perform any inspections set forth in the specification where such inspections are deemed necessary to ensure that the work conforms to the prescribed requirements.

3.3.1 Visual Examination

Significant surfaces of cleaned components shall be visually inspected for the presence of moisture and foreign material such as corrosion, scale, dirt, hydrocarbons, crayon, and similar foreign materials. A flashlight or borescope may be required to examine internal surfaces. The presence of visible contamination shall be cause for rejection and shall necessitate recleaning of the item. Scale-free discoloration due to welding and passivation is permitted.

3.3.2 Ultra-violet Light Examination

Significant surfaces of cleaned components shall be examined using an ultra-violet light having a power of at least 100 watts and producing a wave length of approximately 3660 angstrom 366 nanometer (3660 angstom) units. Presence of fluorescent particles on areas of any surface, metallic or non-metallic, shall be cause for rejection and shall necessitate recleaning of the item. Any component or material, either metallic or non-metallic, from which fluorescence cannot be eliminated shall be rejected and replaced at no further cost to the Government.

3.4 QUALITY ASSURANCE INSPECTIONS

Except as specified herein, the following inspections shall be performed on

all components, assemblies, and systems.

3.4.1 Inspections for Class I Cleanliness Requirements

Visual Examination: As specified, under a strong white light.

Ultra-violet Light Examination: As specified.

3.4.2 Inspections for Class II Cleanliness Requirements

Visual Examination: As specified, under a strong white light.

Ultra-violet Light Examination: As specified.

3.4.3 Inspections for Class III Cleanliness Requirements

Visual Examination: As specified, under a strong white light.

Ultra-violet Light Examination: As specified.

3.4.4 Inspections for Class IV Cleanliness Requirements

Visual Examination: As specified, under normal shop lighting conditions.

3.5 WASTE DISPOSAL

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NOTE: Specific waste collection criteria, defining waste management guidelines that must be followed, should be furnished to the Contractor not later than the pre-construction conference.

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Determination as to whether waste fluids or materials generated during cleaning operations are hazardous, controlled, non-hazardous, or non-controlled shall be made by the [_____].

Contractor shall be responsible for coordinating waste generation activities with the [Hazardous Waste Section] [_____]. As a minimum, the Contractor will be required to furnish suitable containers and/or tankage to collect, transport, and offload the collected waste in designated [tankage] [_____]. Contractor shall be responsible for maintaining sufficient storage for a minimum of five (7) calendar days after the storage is filled to capacity.

[The Government will dispose of hazardous waste and controlled waste.]

Contractor shall dispose of non-hazardous wastes and non-controlled wastes at no additional cost to the Government. Disposal of non-hazardous or non-controlled waste shall be accomplished [offsite as approved by the Government] [_____]. [Disposal of these fluids or materials will not be permitted at [_____].]

3.6 CLEANING

Contractor shall notify the Contracting Officer at least 48 hours prior to the time Government-furnished air, gaseous nitrogen, and demineralized water will be required for cleaning purposes.

All gross contamination shall be removed by mechanical processes, flushing, or high velocity blowdown prior to final cleaning. Mechanical and electrical testing shall be accomplished after precleaning and before final cleaning. All lengths of pipe, fittings, and piping system components shall be precleaned prior to welding and assembly.

Corrosion resistant steel assemblies shall be treated, using pickling and passivating processes, to prevent latent corrosion or contamination.

Assemblies not suitable for cleaning as assembled shall have their parts cleaned prior to assembly or shall be disassembled and cleaned. This shall apply to assemblies composed of materials requiring different cleaning procedures, or assemblies from which cleaning solutions cannot be adequately drained.

Flanged joints shall be loosened as required during the cleaning procedure to assure complete drainage of cleaning and rinsing solutions.

3.7 PROTECTION

For [Class I,] [and] [Class II,] [and] [Class III] cleaning levels, protected components that are not installed shall be placed in a clean polyethylene bag. Bag shall be purged with dry, oil-free gas and the ends of the bag heat-sealed to ensure an inert package during storage. Bagged component shall be placed in a second heat-sealed and purged polyethylene bag with a cleaning certification tag placed in the second bag. Components which cannot be placed in a polyethylene bag shall be given equivalent protection and be tagged near each sealed opening used in the cleaning procedure.

3.7.1 Protection for Class I Cleanliness Requirements

Immediately after precleaning, cleaning and drying, significant surfaces subject to Class I cleanliness requirements shall be protected from recontamination by covering the surfaces or openings with a minimum of two layers of Low Water-Vapor Transmission Film. Film shall be secured and reinforced with pressure-sensitive tape.

3.7.2 Protection for Class II Cleanliness Requirements

Immediately after cleaning and drying, significant surfaces subject to Class II cleanliness requirements shall be protected from recontamination by covering the surfaces or openings with [aluminum foil] [or] [a minimum of two layers of polyethylene film] [or] [precleaned dry covers], secured and reinforced with pressure-sensitive tape.

3.7.3 Protection for Class III Cleanliness Requirements

Immediately after cleaning and drying, significant surfaces subject to Class III cleanliness requirements shall be protected from recontamination by covering the surfaces or openings with [aluminum foil] [or] [a minimum of two layers of polyethylene film] [or] [precleaned dry covers], secured and reinforced with pressure-sensitive tape.

3.7.4 Protection for Class IV Cleanliness Requirements

Drain liquids from all parts of the system and seal openings with [aluminum foil] [or] [polyethylene bags] [or] [approved devices].

3.8 CERTIFICATION TAG SCHEDULE

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NOTE: Edit list as necessary for tags required for the project.
****

CERTIFICATION TAGS

Tag Type	Thickness (inches)	Note "A" (pounds)	Note "B" (grams)	[Tie Wire] [inches]
20	0.020 to 0.022	200 to 240	1,130	[0.025]
15	0.015 to 0.017	150 to 190	850	[0.025]
13	0.013 to 0.015	130 to 170	610	[0.018]

CERTIFICATION TAGS

Tag Type	Thickness (millimeter)	Note "A" (kilograms)	Note "B" (grams)	[Tie Wire] [millimeter]
20	0.51 to 0.56	91 to 109	1,130	[0.64]
15	0.38 to 0.43	68 to 86	850	[0.64]
13	0.33 to 0.38	59 to 77	610	[0.46]

Note "A": Basis weight, 500 sheets, 22-1/2 by 28-1/2 inches 572 by 724 millimeter.

Note "B": Tearing Resistance. Total of both directions, (minimum).

Pre-printed spaces shall be provided for the following information, as applicable. Tag size shall be such that the information is legible when entered by indelible marking pen:

Part or identification number

Manufacturer's serial number

Contractor identification

Cleaning classification and specification identification

Date of cleaning

Service medium or intended use

Pressurizing medium and initial pressure

Title, date, and number of this specification

-- End of Section --